Chapter 10. Civil Construction

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10.1 Introduction

This chapter outlines the civil conventional facilities required to house and support the proposed 8 GeV Proton Driver. An extension of the existing Linac Facility is required housing equipment to bring the beam energy from 400 MeV to 600 MeV. From the new Linac Extension, an enclosure will be required to inject the 600 MeV beam into the Proton Driver. In addition, an enclosure is necessary to carry the 8 GeV extraction line from the Proton Driver to the Main Injector.

10.2 Overview

10.2.1 Civil Construction

Civil Construction, for The Proton Driver, includes all below-grade beamline enclosures and all above-grade buildings, roads, parking, primary utilities, and primary services to accommodate the equipment for the operation of the Proton Driver on the Fermilab site.

The cost estimate for the civil construction, listed in Appendix 1 of this report, has grouped elements in a logical sequence as well as by facility function or type of construction work involved. While the cost estimate organization presents a reasonable construction scenario, it will not be identical with the actual subcontract packages nor is the final schedule of construction inflexible.

10.2.2 Site Construction

10.2.2.1 Wetlands Mitigation includes all of the compensatory floodplain construction.

10.2.2.2 Site Work and Utilities includes survey monuments, temporary power, construction access roads, tree protection, stream diversion, power and communication duct banks, 13.8 kV power feeders, and underground utilities including industrial cold water (ICW), primary cooling ponds, domestic water, sanitary sewer, chilled water supply and return, and final paving of all roads, and hardstand areas.

10.2.2.3 Landscaping includes construction yard removal, signage, site landscaping, and prevention of soil erosion.

10.2.3 Facilities Construction

10.2.3.1 Proton Driver Enclosure is a conventional below grade cast-in-place enclosure constructed to house the Proton Driver beamline.

10.2.3.2 Linac Extension is a conventional above and below grade building to house a new array of Klystrons.

10.2.3.3 Injection Enclosure is a conventional pre-cast enclosure constructed to house the injection beamline from the existing booster to the new Proton Driver enclosure. *A portion of this work must be accomplished during Booster beam off conditions.*

10.2.3.4 Extraction Enclosure is a conventional pre-cast enclosure constructed to house the extraction beamline from the new Proton Driver to the Main Injector enclosure. *A portion of this work must be accomplished during Main Injector beam off conditions.*

10.2.3.5 Proton Driver Service Gallery is an above grade service building used to house support equipment for the Proton Driver Enclosure.

10.2.3.6 Utility Support Building is an above grade utility building used to house equipment for process cooling equipment for the Proton Driver Enclosure.

10.2.4 EDI&A

10.2.4.1 EDI&A consists of all Engineering, Design, Inspection, and Administration costs associated with the Construction aspects of the project.

10.3 Detailed Facilities Descriptions

Construction of the Proton Driver Enclosure, Linac Extension, Extraction Enclosure, Injection Enclosure and above grade service buildings is similar to previously utilized and proven construction methods at Fermilab. Construction of all below-grade enclosures consists of conventional open cut type construction techniques. The architectural style of the new buildings reflects, and is harmonious with, existing adjacent buildings. Currently, the layout has been optimized for the accelerator. Future layouts will consider existing topography, watersheds, vegetation, natural habitat, and wetlands. All these aspects will be thoroughly addressed in the EA for this project.

Safety provisions for radiation, fire protection and conventional safety are included in this Project Definition Report. Energy-efficient construction techniques will be incorporated into all new structures. Quality assurance provisions will be part of all project phases including conceptual, preliminary, and final design, construction, and construction management.

10.3.1 Site Construction

10.3.1.1 Wetlands Mitigation

Detailed and specific definitions of the wetland area, floodplain and storm water management, archaeological concerns and ecological resources will be identified by environmental consultants resulting in the preparation, submittal and approval of a Floodplain/Wetland Assessment Report and an EA. All required permits will be obtained prior the start of construction. See Chapter 11 for environmental considerations.

After the environmental consultants report, modifications may be made on the location of roads, utilities or siting of structures to minimize the impact on the environment while still retaining the ability to construct this experiment in a cost effective manner.

10.3.1.2 Site Work and Utilities

Site Drainage will be controlled by ditches and culverts while preserving the existing watershed characteristics both during construction and subsequent operation. Permanent stream relocation of a portion of Indian Creek may be required for this project.

Minor road construction is anticipated for this project. The existing Kautz Road adjacent to the Antiproton complex will be out of service during construction of the Injection Enclosure. A temporary road will need to be installed to facilitate adequate traffic flow. Parking lots will be required at the Proton Driver Support Buildings.

Power, communications, and chilled water supply and return will tie in to existing systems at the intersection of the Main Injector Road and Kautz Road. These utilities will extend up to the Site.

Industrial Cold Water (ICW) will tie into existing utilities at the corner of Kautz and Giese roads. Primary cooling water will be taken from surrounding existing ponds.

Sanitary Service (SAN) and Domestic Water (DW) will tie into existing utilities at the intersection of Kautz and Giese Roads.

Natural Gas will tie into an existing gas line running along Giese road.

Excess and unsuitable spoil from the construction of the underground enclosures and caverns will be stockpiled on the Fermilab site in an appropriate manner. This material will then be used as nonstructural backfill for future projects.

10.3.1.3 Landscaping

Construction yards will be removed after completion of the construction phase of the project. All disturbed areas will be returned to a natural state or landscaped in a similar manner as found at other Fermilab experimental facilities. Erosion control will be maintained during all phases of construction.

10.3.2 Facilities Construction

10.3.2.1 Proton Driver Enclosure

The Proton Driver Enclosure is a cast in place enclosure 16 ft. wide and 9 ft. high with approximately 24.5 ft. of equivalent earth radiation shielding (26 ft. at all buildings). This region will house beam line components to accelerate protons to an energy of 8 GeV. See TDR-? and TDR-? for location and dimensions.

10.3.2.2 Linac Extension

The Linac Extension is a conventional above and below grade facility with approximately 26 ft. of equivalent earth radiation shielding. The below grade Linac Enclosure is a cast in place enclosure 12 ft. wide and 13 ft. high. The above grade Linac Gallery is approximately 30 ft. 4 in. wide and its height matches existing facilities.

10.3.2.3 Injection Enclosure

The Injection Enclosure is a conventional below grade 10 ft. wide by 8 ft. high precast concrete enclosure with approximately 24.5 ft. of equivalent earth radiation shielding. This enclosure will house the beamline components necessary to transport the 600 MeV beamline from the existing Linac to the proposed Proton Driver Enclosure.

10.3.2.4 Extraction Enclosure

The Extraction Enclosure is a conventional below grade 10 ft. wide by 8 ft. high precast concrete enclosure with approximately 24.5 ft. of equivalent earth radiation shielding. This enclosure will house the beamline components necessary to transport the 8 GeV beamline from the Proton Driver to the existing 8 GeV transport line enclosure. The existing 8 GeV transport line enclosure will be utilized to continue the beamline to the existing Main Injector.

10.3.2.4 Proton Driver Service Gallery

The proposed Proton Driver Service Gallery will consist of three above grade metal frame and wall panel buildings that house the equipment necessary to supply power, instrumentation and control the beamline components housed in the Proton Driver enclosure located below and adjacent to the service buildings. See TDR-? for building locations and dimensions. Total area of the building is approximately 50,000 sq-ft.

10.3.2.5 Utility Support Building

The Utility Support Building will be located in the center of the Proton Driver Service Gallery Campus. The above grade metal frame and wall panel building will house the equipment required for heat rejection and electrical distribution including chillers, pumps, and transformers. Total building area is approximately 12,000 sq-ft.

10.4 Civil Construction Issues for Linac Extension

10.4.1 Level of the new section of Linac

The level of the tunnel connecting the Linac to the new synchrotron should be lower than the existing Linac. Having it at the level of the new synchrotron may be too expensive. An intermediate level is indicated—the level of the current Booster seems appropriate.

10.4.2 Tunnel Dimensions

The tunnel that contains the new coupled-cavity modules for the new 200 MeV addition needs to be large enough to accommodate the cavities, room to move the cavities side-by-side down the tunnel, space for workers to navigate when two cavities are side-by-side and room to maneuver the wave guide from the penetrations to the cavities. Also, the tunnel should be large enough to accommodate conventional cavities or superconducting cavities, as a possible upgrade path. The existing Linac enclosure is artificially large because of the need to contain the massive 200 MHz Alverez structures.

The existing side-coupled cavity modules are about 7 feet 10 inches from the far wall and 3 feet 11 inches from the near wall. This smaller dimension translates to about 2 feet of walk-by space at the location of the wave-guide.

The stand for the modules is 29 inches wide, with an additional 5 inches for a small cable tray attached to the side or 34 inches total. It will be necessary to have two of these modules side-by-side in the tunnel. To maintain the 4-foot aisle on each side the overall width of the tunnel should be twice 4 feet plus 34 inches or a total of 13 feet 8 inches.

The wave-guide comes in from the wall at a top height of 9 feet 4 inches—this dimension would be difficult to reduce, so it will be retained. Thus, the new tunnel needs to be 10 feet high.

In summary, the dimensions of the tunnel should be about 13 feet wide and 10 feet tall.

10.5 Civil Construction Schedule

The following schedule is predicated on the assumption that a funding profile to match the construction needs will be established and maintained.

This schedule has been developed without consideration of the accelerator operation schedule. Work requiring accelerator beam off conditions is assumed to be accomplished during normal scheduled accelerator shutdowns.

	DURATION
Conceptual Design Complete	TØ - 0.25 yrs
Start Title I	TØ
Complete and submit Environmental Assessment (EA)	TØ + 0.25 yrs
Approved Finding of No Significant Impact	TØ + 0.50 yrs
Submit ACOE 404 Permit Application	TØ + 0.50 yrs
Title I Complete, Approval to start Title II	TØ + 1.00 yrs
Obtain ACOE 404 Permit	TØ + 1.50 yrs
Approval to Start Title III (Start Construction)	TØ + 1.75 yrs
Underground Enclosures Complete	TØ + 2.50 yrs
Above Grade Buildings Complete	TØ + 3.25 yrs
Civil Construction Complete	TØ +3.40 yrs
Shielding Assessment Approved - Project Complete	TØ +3.50 yrs

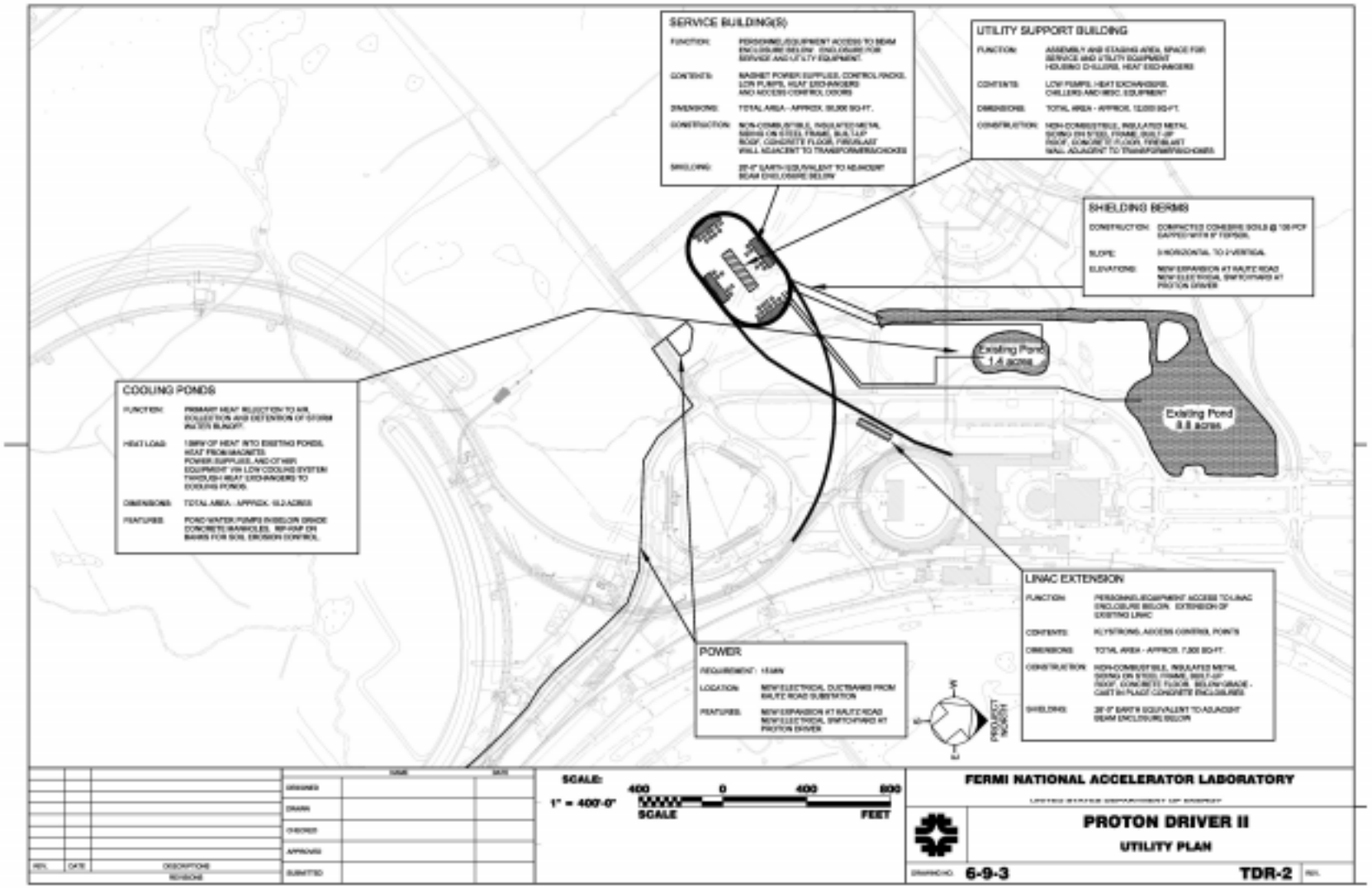

Figure 10.1. Proton Driver II (PD2) Utility Plan.

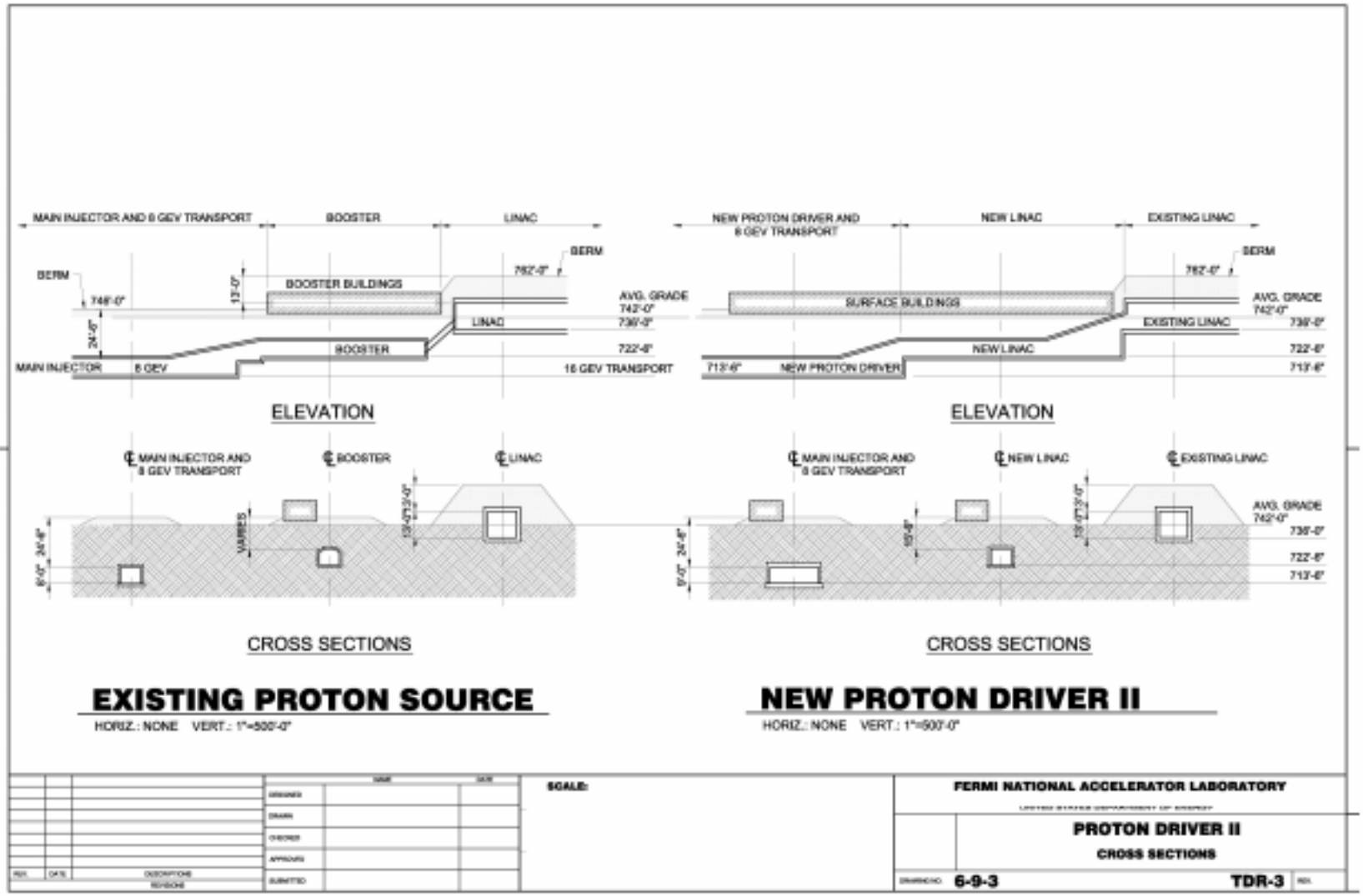

Figure 10.2. Proton Driver II (PD2) Elevation.

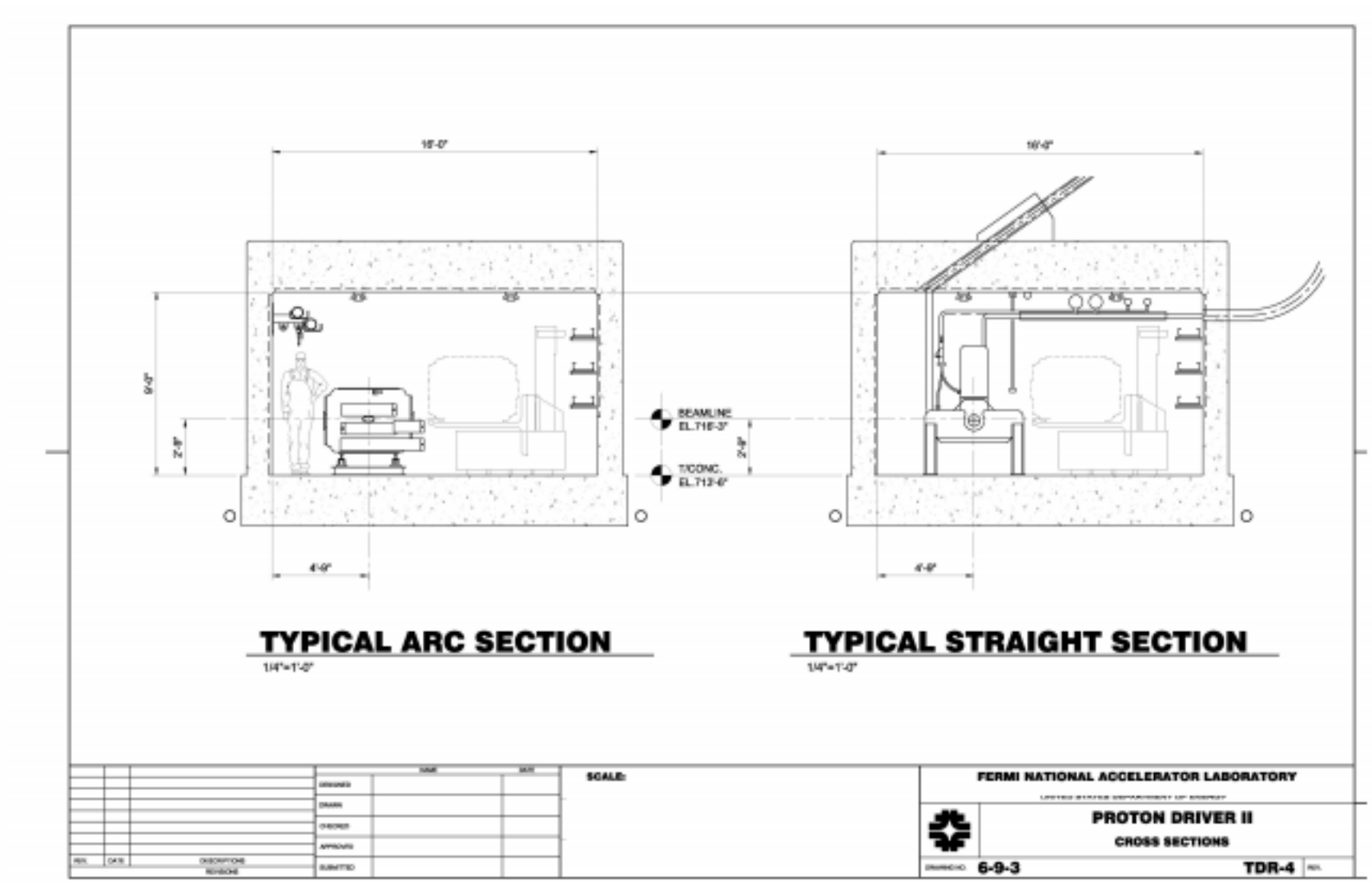

Figure 10.3. Proton Driver II (PD2) Enclosure Cross-Sections.

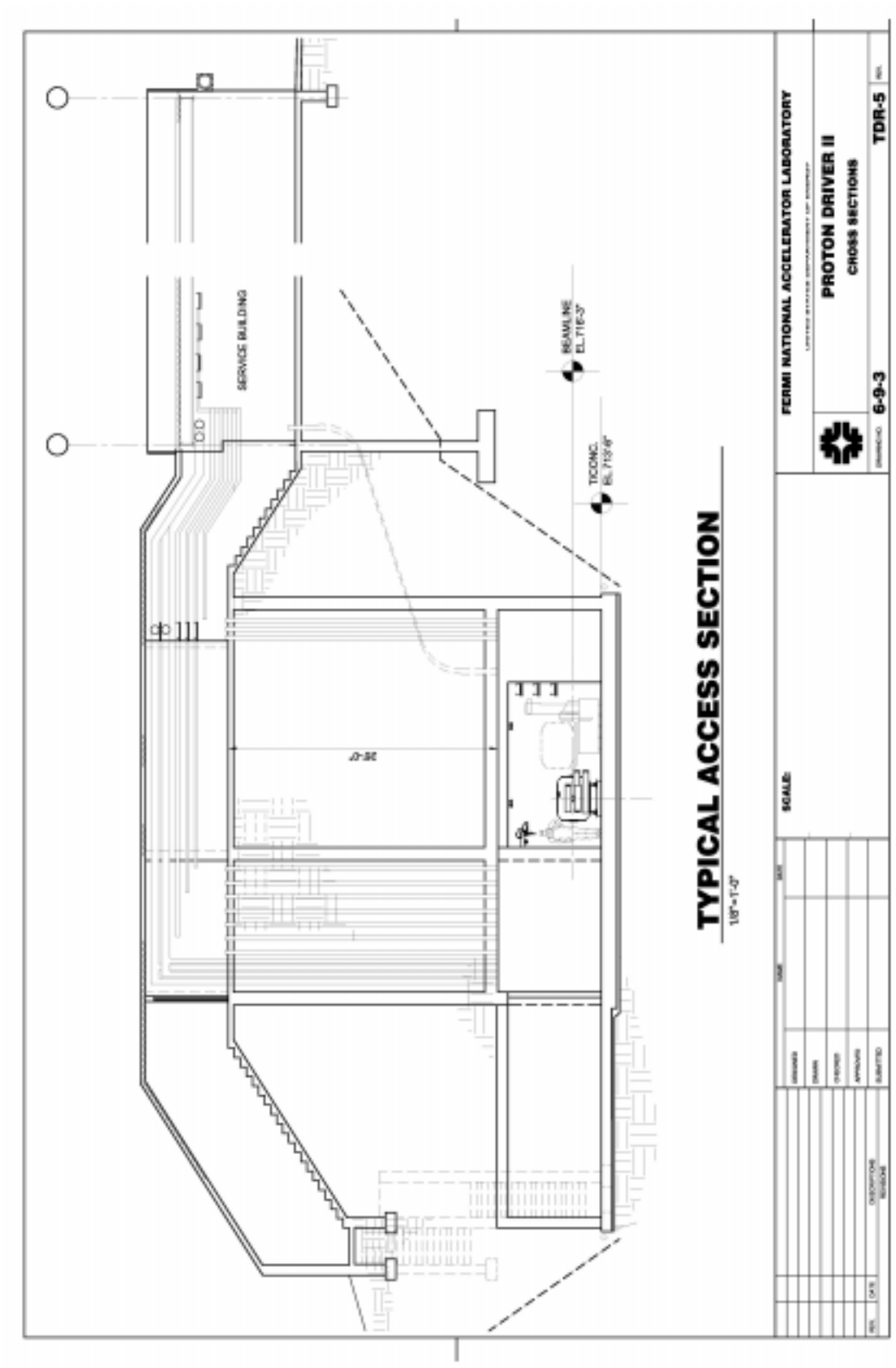

Figure 10.4. Proton Driver II (PD2) Access Section.

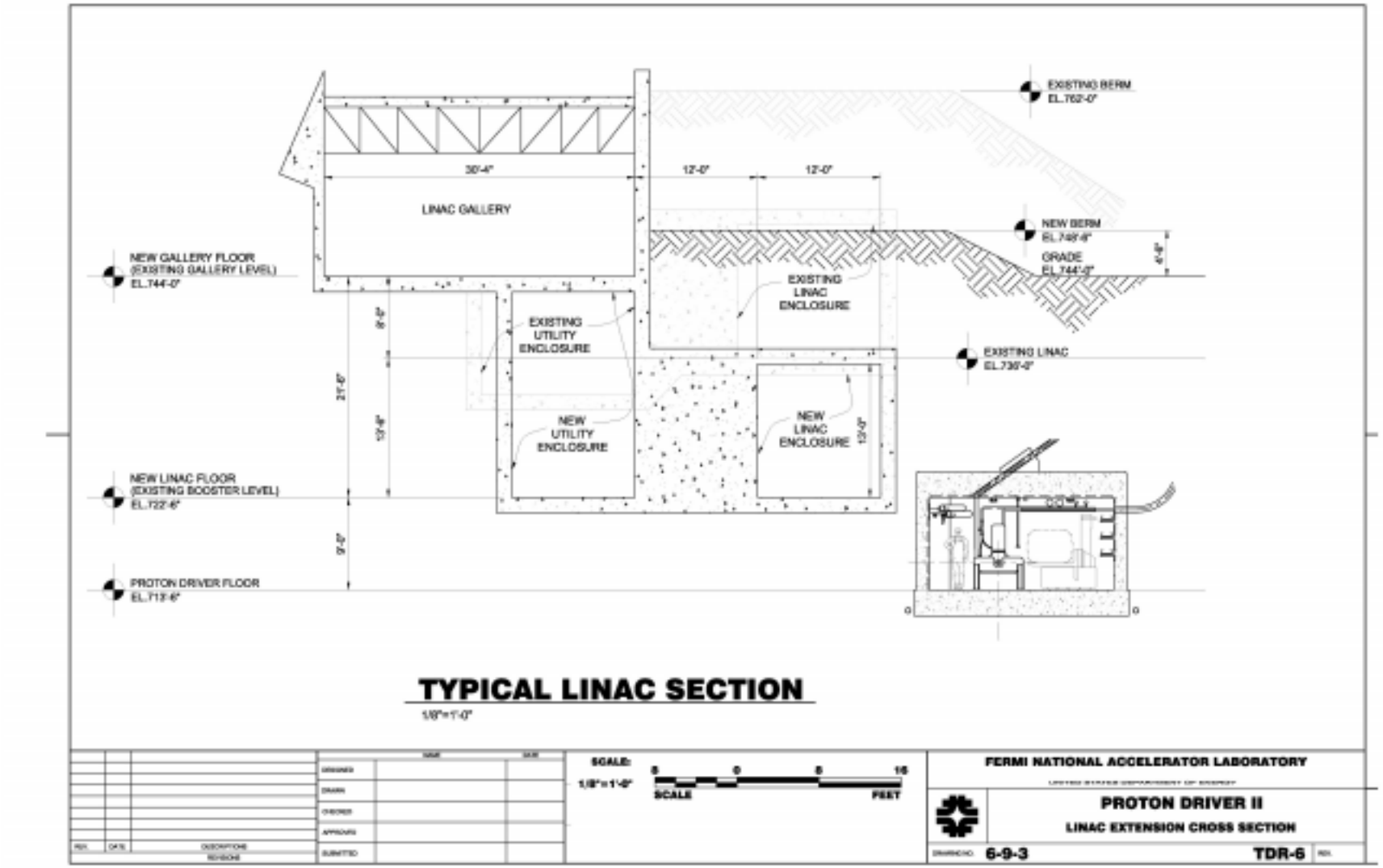

Figure 10.5. Proton Driver II (PD2) Linac Extension Gallery and Enclosure Cross-Section.